Chapter 5

Disasters and Disaster Medicine

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Additional information is available at the end of the chapter

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Abstract

The rate of disaster occurrence has increased greatly in the recent decades in both natural and man-made ones. There are more hurricanes and other natural disasters occurring now than a century ago. In addition, there is marked increase in the terrorist attacks on cities and civilians in both conventional weapons and in chemical and biological ones. The increase in the rate of disasters obliges medical society to pay more and more attention to the disaster response. There are attempts to make the subject of disaster as an independent specialty of medicine because it has unique focus in managing cases and it involves dealing with several issues other than direct medical treatment of patients.

Keywords: natural disasters, man-made disasters, hazard, risks, vulnerability, incident command system, triage

1. Introduction

The frequency of disasters has increased markedly over the last 30 years [1, 2]. This increases the probability that an emergency physician may face a disaster, and he/she needs to be well trained in order to decrease the losses. Moreover, the consequences of the disasters are increased to reach billions of dollars according to **Margareta Wahlström** *(United Nations Special Representative of the Secretary-General for Disaster Risk Reduction)*. In her forward to the Atlas of natural disasters in 2015, she stated that "Economic losses as a result of disasters continue to escalate. In each of the past 3 years direct economic losses from disasters have surpassed $100 billion in the world" [3]. Such threats will lead us to the conclusion that we need to study disaster as a unique phenomenon and have preplanning to manage risks, trying to prevent

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them or decrease their effects on the community, instead of reaction to the disaster itself. As a matter of fact, education and training in disaster medicine are mandatory [4].

2. Definitions and classifications

2.1. Why we need to define and classify disasters?

We need to define and classify disasters to have better knowledge and understanding of the problem. This will enable concerned specialists and leaders to discuss the conditions and responses needed in more detail. The response may include shifting of resources and manpower or preparing alternative places to shift victims. Analysis of disasters shows that all disasters share common characteristics; they include temporal and geographic footprints, triggering hazard (or hazards), and vulnerabilities [5, 6].

Disaster: The word *disaster* is derived from Middle French *désastre* and that from Old Italian *disastro*, which in turn comes from the Ancient Greek pejorative prefix δυσ-, (*dus*-) "bad" and ἀστήϱ (*aster*), "star." The root of the word *disaster* ("bad star" in Greek) comes from an astrological sense of a calamity blamed on the position of planets and ἀστήϱ (aster), "star" [7].

The **linguistic definition** of the world disaster is "a sudden calamitous event bringing great damage, loss, or destruction" [8].

World Health Organization (WHO) definition of disaster: "A **disaster** is an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity of adjustment of the affected community" [9].

United Nation Office for Disaster Risk Reduction (UNISDR) defines disasters as "A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts" [10].

Federal Emergency Management Agency (FEMA) defines disaster as "An occurrence that has resulted in property damage, deaths, and/or injuries to a community. FEMA 1990" [11].

International Federation of Red Cross (IFRC) added another factor to the definition: "A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources." Though often caused by nature, disasters can have human origins [11].

3. Social definition of disaster

The difference between this definition and others is that the previous ones concentrate on the event while this one concentrates on the social phenomena accompanying the event. David Alexander in 2005 reported that disasters are not defined by fixed events, but by social

constructs, and these are liable to change [12]. There is large debate and discussions between sociologists regarding the definition of disasters. There are more than 36 definitions of disasters from sociology perspective. Many scientists are involved in the evolution of the definition. E. L. Quarantelli in 2000 identified disasters in terms of a variety of defining features. They are as follows:

1. Of sudden-onset occasions,
2. Seriously disrupt the routines of collective units,
3. Cause the adoption of unplanned courses of action to adjust to the disruption,
4. Have unexpected life histories designated in social space and time, and
5. Pose danger to valued social objects [12].

4. Quantitative definition of disasters

There are trials to define disasters on the quantitative basis. This has huge variations because disasters, as noticed in the previous definitions, depend on the balance between needs and resources. Depending on that, if there are low resources, then a disaster can occur in a lower scale. On the contrary, if there are many resources then it requires larger-scale events to create a disaster. In the USA, FEMA put the following quantitative descriptions for disaster depending on Lesley Sheehan & Kenneth Hewitt's work in 1969:

"A major disaster was defined as an incident that includes one of the following events:

- At least 100 human deaths, or
- At least 100 human injuries, or
- At least US $1 million economic damages" [13].

If we look at the previous definitions by well-known organizations, we will find that they all agree about the serious effects on community and that community cannot respond to the incident depending on its own resources. The social explanation of the disaster encourages us to make changes in our social system and make improvement on the disaster outcome. Also, it confirms that there is no one definition for disaster.

5. When we consider an incident as a disaster?

The news all over the world provides a substantial number of incidents occurring every day, but not all of them are described as a disaster! Moreover, the same incidents occurring in one area are considered disaster, but if it occurred in another area, it is not.

The outcome of the triggering event by its effects on human and environment decides whether this is a disaster or not. The factors affecting the disaster outcome are (1) scope of

the impact, (2) speed of the impact, (3) duration of the impact, and (4) social preparedness of the community [12].

From this perspective, we can realize the importance of studying disasters, study the disaster response plan, and train the communities on how to respond. With this, we can get a better result in case there is a disaster.

Hazard: "A hazard is an agent which has the potential to cause harm to a vulnerable target" [14]. In disaster medicine, it is: "A Hazard is a potential source of harm or adverse health effect on a person or persons" [15].

Risk: "someone or something that creates or suggests a hazard" [16]. In disaster medicine, it is: "risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard" [15].

Vulnerable: "capable of or susceptible to being wounded or hurt" [17]. IFRC defines it as "the diminished capacity of an individual or group to anticipate, cope with, resist and recover from the impact of a natural or man-made hazard" [18].

For more definitions, please see the links at the end of the chapter.

6. Reasons for increase in disasters

The disasters increased for many reasons are multifactorial: overpopulation, urbanization, expanding industrialization, increased traffic, climate change, ongoing threat of terrorism, and armed conflicts

1. The world population shows an increase from 1.6 billion in 1900 to 7.8 billion in 2017, with disproportionate growth in developing countries [19, 20].
2. A rapid-expanding industrialization especially in the chemical industry involving production, storage, and transportation of rapidly ever-increasing amounts of toxic and explosive agents, often in and through densely populated areas and with insufficient safety measures [21].
3. An increased traffic density of people and goods in more rapid and higher capacity modes of transport [22, 23]. Increasing international trade and travel provides myriad opportunities for the emergence or re-emergence of infectious disease threats and other public health risks [21].
4. Global climate change makes people susceptible to severe weather events, especially the coastal communities around the world [24, 25].
5. A continuous threat of terroristic acts [26, 27].
6. Armed conflicts with a high vulnerability of the civilian population to forced migration or displacement heightening the risk of infectious disease epidemics. A collateral impact of armed conflicts is often the destruction or malfunctioning of health systems [21, 27].

Considering the reasons for increased disasters in the world, we can notice that many of those are related to human behavior. Wrong decisions made by human lead to the occurrence of

disasters like deforestation leading to landslides and global warming leading to increase in floods and cyclones. Sometimes, it leads to an increase in the effects of them, for example, badly distributed population with little safety precautions in houses, bad health systems, or increase in transportation all escalated the negative effects of infections and faster and wider distribution.

7. Disasters are social phenomena

Building upon the notes in the previous paragraph, several experts changed the concepts of disaster from a natural phenomenon for which nothing can be done to a social act which can be changed and manipulated to prevent it or decrease its effect.

The focus of studying disasters shifted from the causative agent-centered approach to the vulnerable population approach by researchers like David Alexander, Dennis Mileti, and Allen Barton. This concept leads to a change in the results and outcomes of disasters [28].

E. L. Quarantelli, 1992, stated in his article "The Importance of Thinking of Disasters as Social Phenomena" that it is not causative agent or the triggering event that makes the disaster. It is argued, *disasters are, one way or another, primarily the results of human actions*. A disaster is not a physical happening, it is a social event. There is a conjuncture of certain physical happenings and certain social happenings. Therefore, if there is no human injury or loss and/or no environmental effect, then there is no disaster [29].

8. Why we study disasters

There are several reasons for studying disasters as follows:

1. Although disasters are of diverse types and effects, their medical responses have common features. The needs are always more than the resources in disasters which need changes in our focus from individual benefit to community benefit. Also change in the way of delivering the care.
2. Majority of hazards have return periods on a human time scale. Examples include a 5-, 50-, and a 100-year flood. This reflects a statistical measure of how often a hazard event of a given magnitude and intensity will occur. The frequency is measured in terms of a hazard's recurrence interval [30].
3. Studying will help planners to make better plans and preparation to avoid needless life losses and decrease the effects of the disasters expected in any area.

9. Consequences of disasters

Hazardous process of all types can have primary, secondary, and tertiary effects:

1. ***Primary effects*** occur because of the process itself. For example, water damage during a flood or collapse of buildings during an earthquake, a landslide, or a hurricane.

2. ***Secondary effects*** occur only because a primary effect has caused them. For example, fires ignited because of earthquakes, disruption of electrical power and water service because of an earthquake, a flood, or a hurricane, or flooding caused by a landslide into a lake or a river.
3. ***Tertiary effects*** are long-term effects that are set off because of a primary event. These include things like loss of habitat caused by a flood, permanent changes in the position of a river channel caused by flood, crop failure caused by a volcanic eruption, and so on [31].

10. Classification of disasters.

Classification of disasters has several benefits:

1. It helps in better understanding of the disasters and helps interchange information regarding disasters in some detail.
2. It helps in the planning process and the types and amounts of resources devoted for response to each category.
3. It facilitates the response to a disaster by better knowledge and training on similar disasters.

Disasters are classified in a variety of ways:

1. Classification according to the triggering event: A common system divides incidents into natural and technological (human-made) disasters. There is a crossover between the two types, for example, a building collapse due to a hurricane or an earthquake [32].

   1.1. Natural hazards: They are naturally occurring physical phenomena caused by either rapid- or slow-onset events [33]. They are caused by nature, and men have no control over them. Earthquakes, tsunamis, floods, landslides, hurricanes, wildfires, droughts, and volcanic eruptions are some examples of natural disasters. Such disasters cause massive loss of life, property, and many other miseries. **Table 1** shows the different subgroups of the natural disasters [34].

Natural Disasters				
Biological	**Geophysical**	**Hydrological**	**Meteorological**	**Climatological**
Epidemics of • Viral, • Bacterial, • Parasitic, • Fungal, • Prion **Insect infestation**	**Earthquake, Volcano, Mass Movement (Dry)** • Rock fall, • Landslide, • Avalanche, • Subsidence,	**Flood:** • General flood, • Flash flood, • Storm surge/coastal flood **Mass Movement (Wet)** • Rock fall, • Landslide, • Avalanche, • Subsidence	**Storm:** • Tropical cyclone, • Extra-tropical cyclone. • Local storm.	**Extreme temp.** • Heat wave, • Cold wave, • Extreme winter condition. **Drought** **Wild fire** • Forest fire, • Land fire.

Table 1. Classification of natural disasters.

1.2. Technological (or man-made) hazards are events that are caused by humans and occur in or close to human settlements [33]. Man-made disasters are less complicated and occupy smaller areas making them easier to control [35]. **Table 2** shows the man-made disasters with its subgroups and examples [36].

2. Classification based on the speed of onset

2.1. Rapid-onset disasters

Hazards that arise suddenly, or whose occurrence cannot be predicted far in advance, trigger rapid-onset disasters. Earthquakes, cyclones and other windstorms, landslides and avalanches, wildfires, floods, and volcanic eruptions are usually categorized as rapid-onset events. The warning time ranges from seconds or at best a few minutes in the case of earthquakes and many landslides, to several days in the case of most storms and floods. Some volcanic eruptions may be preceded by weeks or months of activity, but predicting volcanoes' behavior remains very difficult and the warning time for the eruption itself may be only days or hours. Most disasters are rapid-onset events [37].

2.2. Slow-onset disasters

Most discussion of slow-onset disasters concentrates on one hazard: drought. It can take months or sometimes years for the results of drought to become disastrous, in the form of severe water and food shortages and, ultimately, famine. Other examples are pollution of the environment, and human activities that degrade the environment and damage ecosystems (deforestation for instance) also contribute to disasters. Their cumulative impact may not be felt for decades, although the hazards that they make more likely, such as flash floods and landslides, may be sudden-onset events [37].

Man-Made (Human-Induced) Hazards		
Hazard Sub-Family	**Hazard Type**	**Hazard Sub-Type**
Technological Hazard	Structural Collapse	Standing Structure
		Underground Structure
	Utility Failure	
	Fire	
	Explosion	
	Contamination[23]	Chemical Contamination
		Hydrocarbon Contamination
		Radiation Contamination
Transport Hazard	Crash/Collision	Road
		Rail
		Water
		Air
		Space
Social Hazard	Social	Riot
		Stampede
	Economic	Currency Devaluation
		Mass Bank/Corporate Failures

Table 2. Classification of technological (man-made) disasters.

3. Classification according to **severity and who provide the resources**:

3.1. Level I disaster is one in which local emergency response personnel and organizations can contain and effectively deal with the disaster and its aftermath.

3.2. Level II disaster requires regional efforts and mutual aid from surrounding communities.

3.3. Level III disaster is of such a magnitude that local and regional assets are overwhelmed, requiring statewide or federal assistance and may even need international help.

This classification reflects a tiered response, which is a fundamental principle of the National Response Framework, a component of national disaster response planning in the United States [30].

4. **Simple and compound disasters:**

4.1. Simple disasters: the location's infrastructure remains intact and effective. Communication is possible. Health system and other emergency services work [38].

4.2. Compound disasters: all or most of the infrastructures are disrupted. Communication is difficult; roads, electricity, and water supply are unavailable. Hospitals may be affected, and there is no place to treat the victims [38].

5. **Complex disasters:**

This is a special kind of disasters in which there is a combination of both man-made and natural causes threatening the livelihood of people. It can be caused by wars and civil disturbance. Rescue operation may be done which is critical and risky to the environment [39].

Such "complex emergencies" are typically characterized by

- extensive violence and loss of life;
- displacements of populations;
- widespread damage to societies and economies;
- the need for large-scale, multifaceted humanitarian assistance;
- the hindrance or prevention of humanitarian assistance by political and military constraints;
- significant security risks for humanitarian relief workers in some areas [40].

6. **Compensated and uncompensated major incidents**:

Countries using this classification differentiate between major incidents and disaster:

6.1. Compensated major incidents are incidents in which there are sufficient local resources to deal with the consequences [38, 41].

6.2. Uncompensated major incidents occur where the medical and other responding emergency services are totally inadequate. This is a disaster condition [38, 41].

7. **Possibilities for further casualties**:

   This classification depends on the possibilities of continuous injuries and victims or no:

   7.1. Static: no more casualties are expected after evacuating the scene, for example, motor vehicle collision [42].

   7.2. Dynamic: more casualties are expected as long as the disaster is active, for example, continuing wildfires [42].

11. Disaster severity

The severity index is used to assess the severity of any disaster. It depends on seven factors [43]:

1. Effect of the disaster on the surrounding community: if the effect is simple, it scores 1 and becomes 2 if the effect is compound.
2. Man-made versus natural: man-made disasters score 0 while natural disasters score 1.
3. Duration of the disaster:

Duration	Severity
Less than 1 h	0
1–24 h	1
More than 24 h	2

4. The radius of the area in which the casualties are fallen:

Area radius	Severity
Less than 1 km	0
1–10 km	1
More than 10 km	2

5. Number of casualties:

Number of casualties	Severity
Less than 100	0
100–1000	1
More than 1000	2

6. Average severity of the injuries sustained:

Average (S) = $T1$ + $T2/T3$.

No. of severe cases	Severity
$T1$ + $T2$ < < $T3$	0
$T1$ + $T2$ nearly equal $T3$	1
$T1$ + $T2$ > > $T3$	2

7. Medical rescue time: rescue, primary treatment, and transportation.

Time	Severity
Less than 6 h	0
6–24 h	1
More than 24 h	2

From the above mentioned factors, we can see that the severity index of disasters can lead to a score which make the basis upon which disasters can be compared with confidence and can be used for further study of disasters. **Figure 1** shows the relation of severity index (S) and disaster severity scale (DSS) with examples [44].

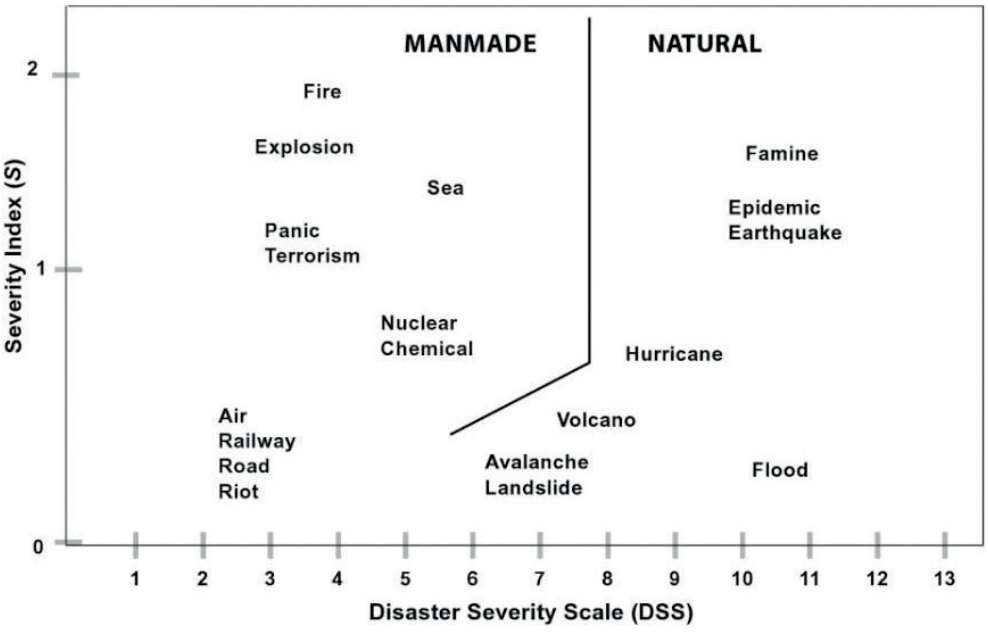

Figure 1. Disaster severity scale (DSS) versus severity index (S) for man-made and natural disasters. Adapted from de Boer and van Remmen (2003).

12. Disaster stages

The time frame for a disaster is a principal factor in innovating methods for management of the disaster. Quarantelli in 1980 divided the time factor into three phases [45, 46]:

1. **Pre-impact phase**: In this phase, there is enough time for investigating choices, inventing ways to prevent or mitigate the disasters, and training communities on the methods. Strategic planners and leaders are involved in this phase. They will make the needed large-scale decisions and policy shifts intended to change people's perception of risk.
2. **Trans-impact phase**: This phase includes the period that is immediately before, during, and after event. Policymakers and operation leaders are involved and are under strong time pressure to deal with the effects of disasters.
3. **Post-impact phase:** This phase includes two subphases, the early and late phases. In the early one, there is a need to restore pre-impact norm. In the late phase, there is a need to set new norms to prevent or mitigate future disasters.

13. Disaster management life cycle

Definition: It is the discipline dealing with and avoiding risks. It is a discipline that involves preparing, supporting, and rebuilding society when natural or human-made disasters occur [47].

To reach the best expected response during the impact of a disaster, a community should perform several steps long before the disaster had occurred. There should be a study of the area and expected hazards, know the available resources, then make a plan and train people on the plan. In such circumstances, we expect the best response in case there is a disaster. In other words, we need to have a planned response instead of reflex reactions [3].

The process of disaster management involves four phases: mitigation, preparedness, response, and recovery. Those stages can be divided according to the disaster phase as shown in **Figure 2**.

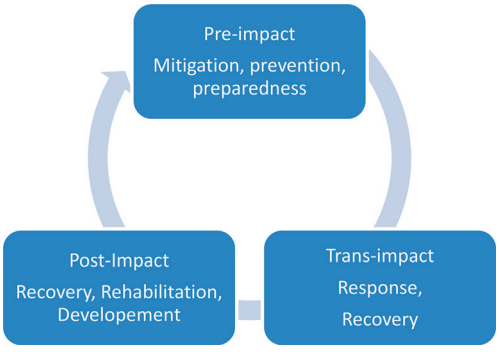

Figure 2. Disaster management components in relation to disaster phases.

All our responses follow models consciously or subconsciously. The benefits of incorporating a model for disaster management are as follows [48]:

1. Using a model simplifies complex events by helping leaders to distinguish important issues which need actions and set priorities.
2. It helps in better understanding of the current disaster situation and expected evolvement of the disaster.
3. It is important in quantifying disaster events.
4. It helps in establishing a common base for understanding the disaster management cycle by all involved personnel.
5. It helps disaster management to explain the course of the disaster and its future evolvement to nonspecialists.

There are important points we need to consider before studying models. First, rapid change may be considered the single principal factor in changing an event into a disaster. Second, chaos may look like a random behavior, but its behavior remains unstable over time that stays within boundaries. Chaos is good and is required to accommodate and adapt to changes. Finally, dividing the disaster into stages is important for theory only; otherwise, the actions are more important and there is no benefit of knowing the stage if a leader cannot make the right decisions [48].

An overview of the models is listed subsequently and will be briefly explained hereafter [47]:

1. The traditional model.
2. The circular model.
3. The expand contract models.
4. The disaster crunch and release models.
5. Manitoba model.
6. Comprehensive model.

13.1. Traditional model

This is the mostly used model. It consists of two phases only: pre-disaster that contains the mitigation, prevention, and preparedness; the second phase is post-impact in which the response, recovery, and development is present. The drawback of this model is the sharp separation between the pre-and post-disaster phases [49]. In addition, data integration and decision making are not easily made in it. **Figure 3** shows the phases of this model [50].

13.2. The circular model

This model was proposed by Richard Kelly; he divided the disaster management cycle into eight phases to reduce the complexity of disasters and handle the nonlinear nature of disaster

events. The main advantage of this model is the ability to learn from the actual disaster. It requires a database with training and a high technological infrastructure to obtain reasonable results [50]. **Figure 4** shows the model [48].

13.3. The expand contract model

This model presents the phases of disaster-risk reduction as a parallel series of activities. All the stages of the cycle are continuously present. The concentration on each stage depends on

Figure 3. Traditional model.

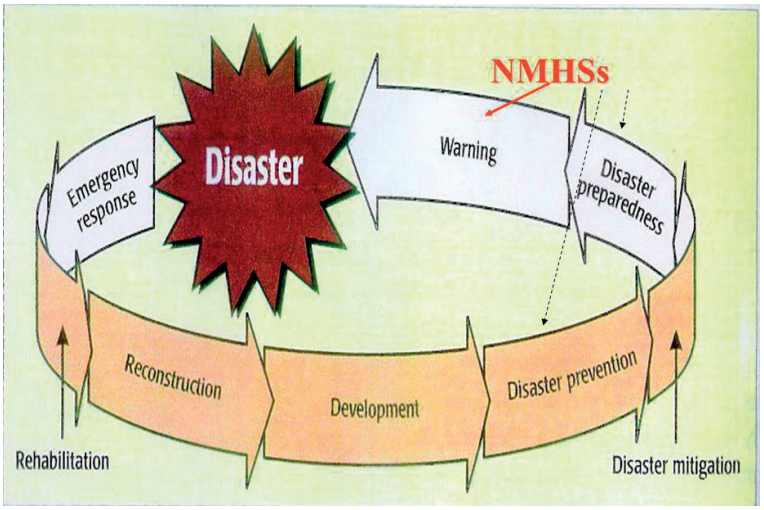

Figure 4. Kelly circular model.

the phase of the disaster. Before the disaster impact, there is concentration on mitigation and preparedness, while during the trans-impact phase the response part of the cycle gets more attention and highest weight [47]. This model overcomes the major weakness of the disaster traditional model, which regards disasters as managed in a phased sequence [5, 47, 50] (**Figure 5**).

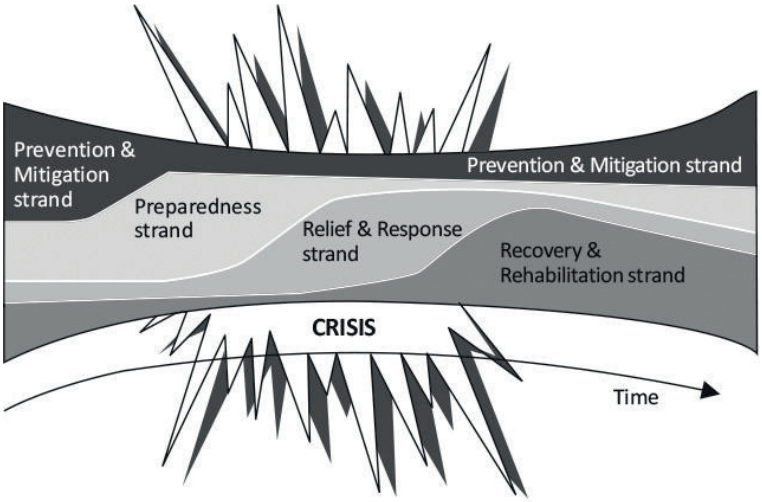

Figure 5. The expand contract model [50].

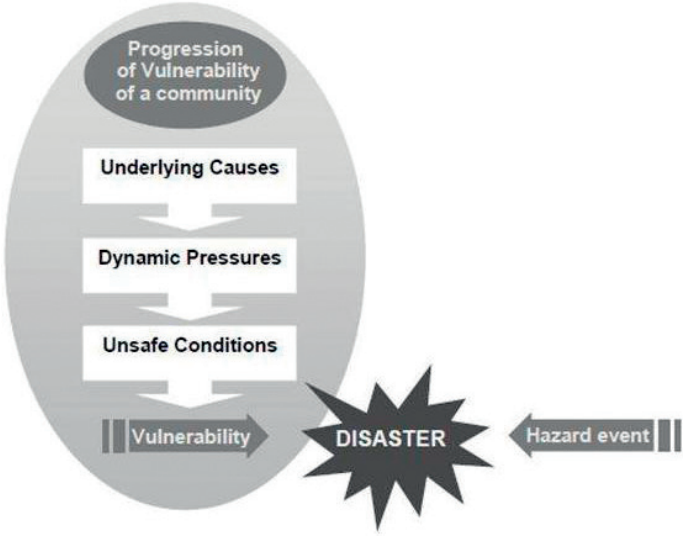

Figure 6. The crunch model.

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Figure 7. The release model [47].

Figure 8. The Manitoba model.

13.4. The disaster crunch and release models

The disaster crunch model states that a disaster occurs only when a hazard affects vulnerable people [51] (**Figure 6**). It concentrates on the causes of disasters and how the impact can lead to them. On the other hand, the release model concentrates on the risk reduction and hazard prevention and mitigation (**Figure 7**).

13.5. Manitoba model

It separates the disaster cycle into six stages; each one has its own boundaries and limitations. The balance between preparedness and flexibility is considered a main advantage of this model. **Figure 8** shows the Manitoba model [52].

13.6. The comprehensive model

The previous models are meant to deal with certain aspects of the management cycle; therefore, they do not help decision makers in all phases of the cycle. The comprehensive model is built to link all aspects of the cycle with the disaster response acts in each phase [53]. **Figure 9** shows the comprehensive model.

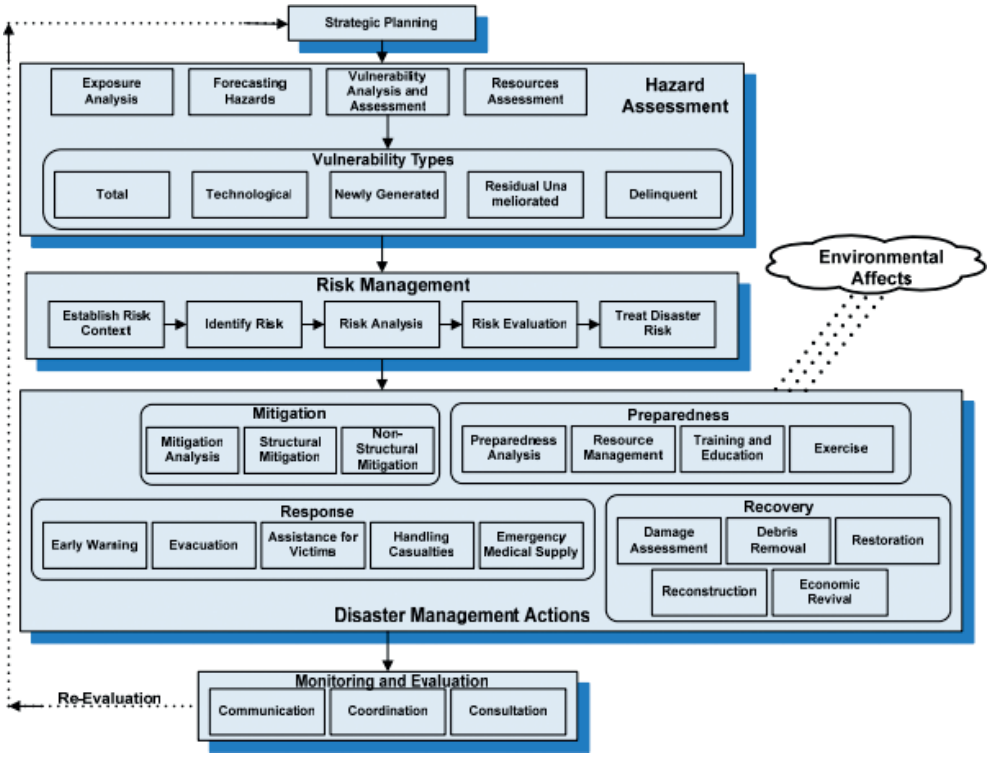

Figure 9. The comprehensive model.

14. Disaster planning

Having good knowledge on the disaster management cycle and the models, it is time to advance for discussing the disaster planning.

- Prerequisites for planning [54]:
  - recognition that hazards and vulnerability exist and that emergencies can occur;
  - awareness among the community, government, and decision;
  - makers of the need to plan and of the benefits of planning;
  - appropriate legislation to guarantee implementation of the plan;
  - a designated organization responsible for coordinating both planning and response recovery in the event of a disaster.
- Concepts of disaster management [54]:
  - All hazards approach: This means that the set of actions put in the plan should be flexible to accommodate several types of hazards. Even if there are counteract measures for some hazards, it is desirable to make this type of response.
  - Comprehensive approach: This means all phases of the disaster cycle which include mitigation, preparedness, response, and recovery.
- **Mitigation:**

Mitigation is defined as: "The act of making a condition or consequence less severe" [55].

In the medical field, it is defined as "the effort to reduce loss of life and property by lessening the impact of disasters. It is most effective when implemented under a comprehensiv, long-term mitigation plan" [56]. The mitigation deals with the identification of the risks and trying to prevent them or decrease their effects. The fundamental steps in risk management are as follows:

1. Risk identification,
2. Risk impact assessment,
3. Risk prioritization analysis,
4. Risk mitigation analysis.

These steps are better described with their relation and interaction as shown in **Figure 10** [57].

Cost-effective mitigation measures on long term are the key for reducing disaster losses on long term and **Table 3** lists the examples of measures that are not exhaustive [57].

- **Preparedness:**

Merriam Webster dictionary defined preparedness as: "the quality or state of being prepared; *especially*: a state of adequate preparation in case of war" [58].

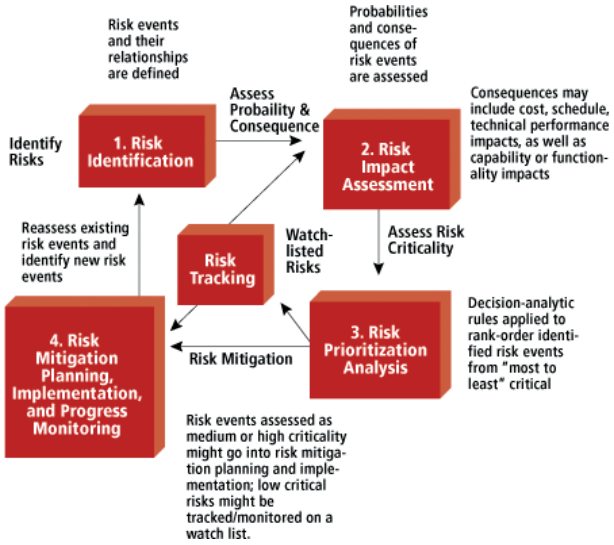
Risk events and their relationships are defined
Probabilities and consequences of risk events are assessed
Assess Probability & Consequence
Consequences may include cost, schedule, technical performance impacts, as well as capability or functionality impacts
Identify Risks
1. Risk Identification
2. Risk Impact Assessment
Reassess existing risk events and identify new risk events
Risk Tracking
Watch-listed Risks
Assess Risk Criticality
4. Risk Mitigation Planning, Implementation, and Progress Monitoring
3. Risk Prioritization Analysis
Decision-analytic rules applied to rank-order identified risk events from "most to least" critical
Risk Mitigation
Risk events assessed as medium or high criticality might go into risk mitigation planning and implementation; low critical risks might be tracked/monitored on a watch list.

Figure 10. Fundamental steps in risk analysis [57].

• Zoning/land-use management	• Building codes and building use regulations
• Relocation of people living in vulnerable and risky areas.	• Safety improvements, for example, annual technical care checking.
• Legislations to put disaster response plan.	• Public information
• Community awareness and education	• Tax, insurance incentives or disincentives

Table 3. Examples of cost-effective mitigation measures.

IFRC defines preparedness as: "Disaster preparedness refers to measures taken to prepare for and reduce the effects of disasters; that is, to predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences" [59]. It takes the results of mitigation and uses it to prepare the community on how to deal with them.

The goal of preparedness is to raise the ability and readiness of a community, an organization, or a country to respond timely and efficiently to any disaster that may occur. The basic components of disaster preparedness involve the following [60]:

1. Identifying organizational resources,
2. Determining roles and responsibilities,
3. Developing policies and procedures and planning activities.

- **Response:**

Response in biology means: "Any behavior of a living organism that result from an external or internal stimulus" [61].

In disaster perspective, response encompasses the decisions and actions taken to deal with the immediate effects of an emergency [62]. Usually, it is for a short period of hours or days starting from the time of the impact or shortly before that if there are predicting signs like hurricanes. Response plan is the best put with the preparedness and whole plan to make a complete coordinated plan rather than making a fragmented plan and there is difficulty in incorporating the different fragments together [54].

Medical response during disaster can be summarized in the CO-S-TR Model framework [63]. This framework can be expressed by 4Cs, 4Ss, and 4Ts as shown in **Table 4**.

The first column (C4) in **Table 4** deals with the higher-management level and reaching the frontline staff in direct response to the disaster.

The second column (S4) looks on the surges of the resources to accommodate the increase in demands because of the disaster.

The third one (T4) deals with victims, how to define and follow them in different places, and how to deliver treatment to them in different places.

- **Recovery:**

It is the restoration or return to any former and better state or condition [64]. In disaster medicine, recovery for hospitals is defined as: "The process by which a hospital minimizes the impact an emergency has made on its operations in an effort to resume normal operations or establish new norms for operations" [65]. The concept of recovery has changes over years from regaining normality in four added-on steps proposed by Hass et al. in 1977 [66] to a more long and complex process that incorporates all other phases of the disaster [67]. To get best results and rapid regain of normality, recovery planning should be incorporated with mitigation process [68]. In disasters with a short response time, recovery starts after ending the acute phase. However, if the disaster took a long time, then review the situation every 12-h period and assess the possibility of starting the recovery processes. Sometimes, in long-lasting disasters, both response and recovery processes go side by side. We can divide recovery into three stages:

1. **Early recovery**: in this stage, regaining the basic services and trying to work as normal as possible or having a new normal. For example, working in an alternative place and this becomes the new normal place.

CO-S-TR framework		
C4	**S4**	**T4**
Command	Staff	Tracking
Control	Stuff	Triage
Communication	Space	Treatment
Coordination	Special	Transportation

Table 4. An outline of CO-S-TR framework.

2. **Rehabilitation**: in this stage, save the undamaged issues, restore the restorable, and try to go back to pre-disaster condition. In the example in the first point, work to fix and rebuild the health-care facility is done in this stage.

3. **Development**: this will be a long-lasting stage (maybe to the next disaster impact); it will intermingle with the mitigation plan, and in it, new standards are set in the building codes or electricity sources to decrease the harmful effects of disasters and go back to normality more rapidly with less damage or work with better efficiency. In the same example as discussed earlier, building or making modifications in other buildings to use them as alternative places will serve patients in time of disaster.

15. International efforts to deal with disasters

There are disasters, mostly natural ones, with scale beyond the ability of the country. Such disasters need the cooperation of the international community to deal with them. The earthquake in Pakistan in 2004, tsunami in 2005, and the earthquake in Haiti in 2011 are just recent examples of such disasters. One of the problems faced during such huge efforts is the duplication of some aspects of the humanitarian acts and missing of some other aspects. This leads to the foundation of the Sphere project under the care of the UN. It was launched in 1997 to develop a set of minimum standards in core areas of humanitarian assistance [69]. For better arrangements and coordination of the various organizations involved in the response, the cluster approach was developed to coordinate the efforts. **Figure 11** shows the cluster approach with the organizations' responsibilities [70].

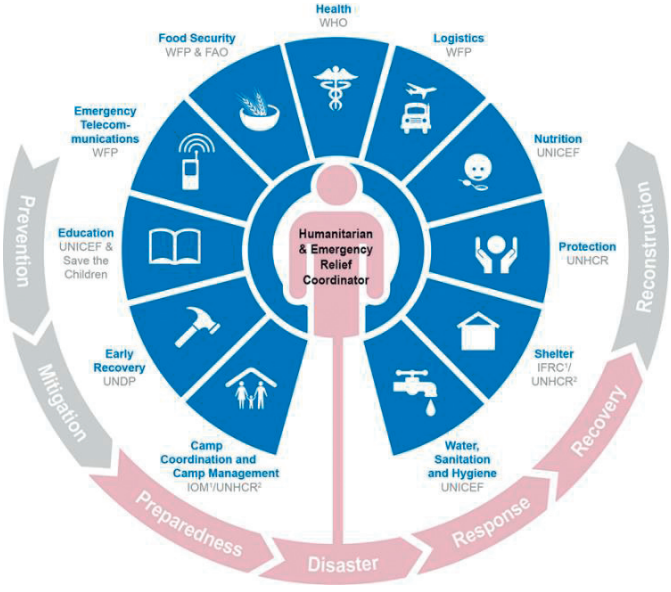

Figure 11. The cluster approach.

16. CBRNE

This abbreviation denotes the use of abnormal or unusual agents which are as follows:

- C: chemical,
- B: biological,
- R: radiological,
- N: nuclear, and
- E: high-yield explosives.

These weapons can create large disruption in terms of the number and level of wellness of the community. Details are beyond the scope of this book.

17. Conclusion

Disaster is a special situation requiring different management styles and techniques. It is mainly the difference in number which exceeds the resources, and for its proper management there is a desperate need for planning to recall staff and surge space and stuff. There are situations which require the utilization of the entire country's resources, while others may even necessitate international aid. The recent examples of Haiti earthquakes, Iraq and Syrian mass immigration due to internal wars, and anti-terrorism war are still going on.

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Conflict of interest

I have no conflict of interest of any sort.

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